NUTRITION AND MORTALITY SMART SURVEY

FINAL REPORT

TADAMON LOCALITY, SOUTH KORDOFAN STATE, SUDAN

Funded by:

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Acronyms

AAH	Action Against Hunger
CMAM	Community Management of Acute Malnutrition
CMR	Crude Mortality Rate
ENA	Emergency Nutrition Assessments
GAM	Global Acute Malnutrition
HAZ	Height for Age Z scores
HH	Household
IPC	Integrated Food Security Phase Classification
MAM	Moderate Acute Malnutrition
MUAC	Mid Upper Arm Circumference
NIS TWG	Nutrition Information Technical Working Group
OTP	Out-Patient Therapeutic Programme
PPS	Probability Proportional to Size
RUSF	Ready to Use Supplementary Food
RUTF	Ready to Use Therapeutic Food
S3M	Simple Spartial Survey Method
SAM	Severe Acute Malnutrition
SD	Standard Deviation (measure of spread around the mean)
SMART	Standardized Monitoring and Assessment for Relief and Transitions
TSFP	Targeted Supplementary Feeding Program
U5MR	Under 5 Mortality Rate
UNICEF	United Nation Children's Fund
WAZ	Weight for Age Z scores
WFP	World Food Program
WHO	World Health Organisation
WHZ	Weight for Height Z scores
WRA	Women of Reproductive Age

Executive summary

Action Against Hunger Spain, in partnership with the Federal Ministry of Health of Sudan, and with funding from Global Affairs Canada (GAC) conducted a SMART nutrition and mortality survey in Tadamon locality, South Kordofan State, Sudan. The aim of the survey was to determine the current prevalence of acute malnutrition and chronic malnutrition, as well as the crude and under-five retrospective death rates, and to analyze the potential causes of malnutrition in Tadamon.

The survey design was a cross-sectional study, employing the Standardized Monitoring and Assessment for Relief and Transitions (SMART) methodology, which applies the two-stage cluster sampling and random sampling techniques. In this survey, a total of 527 households in 39 clusters were sampled. Anthropometric measurements were taken from 621 eligible children aged 6-59 months in the sampled households, while mortality interviews targeted all the household members. Mothers or caregivers were interviewed to collect data on children's health status, as well as the infant and young child feeding practices.

The prevalence of GAM based on Weight-for-Height <-2 Z scores and/or oedema for Tadamon locality was 17.2% (13.8-21.3 95% C.I.), while the prevalence of SAM based on Weight-for-Height <-3 Z scores and/or oedema was 3.4% (2.3 -5.2 95% C.I.). The GAM prevalence indicated a critical nutrition situation based on the WHO acute malnutrition threshold. The prevalence of SAM is considered high based on routine acute malnutrition screening data regularly collected by health and nutrition agencies. No case of oedema was reported during the assessment. The prevalence of GAM based on MUAC < 125 mm was 6.3% (4.3-9.1 95% C.I), while SAM based on MUAC<115 was 1.6% (0.8-3.3 95% C.I.).

The crude death rate and the under-five death rate were 0.37 (0.17-0.82) and 0.32 (0.08-1.32) respectively. Both the CDR and the U5DR were below the WHO emergency thresholds of 1/10,000/day and 2/10,000/day respectively. Most deaths were caused by illness (75.0%), and all reported deaths occurred in the deceased members current location, which were the households surveyed.

Measles immunization coverage both by card and recall was 76.3%, which was lower than the World Health Organization (WHO) recommended standard of ≥80%.

Over one-third (37.2%) of the children had experienced illness in the two weeks that preceded the survey. The three most common childhood illnesses showed the following rates: fever (32.9%), cough (32.9%), and diarrhea (10.8%). Notably, 51.9% of the children who were sick had other illnesses such as malaria, vomiting, eye infection, ear infection, tonsilitis and a few others. Nearly half of the caregivers (49.4%) sought medical treatment when their children were sick, 31.2% bought medicine from pharmacies, 7.8% sought alternative treatment and 11.7% did not seek treatment. Of those who sought treatment from health facilities, 48.5% visited public health facilities.

Using the final sample size that was calculated for this survey, infant and young child feeding indicators were evaluated. The findings of the IYCF assessment should be interpreted with

caution due to the small sample size. IYCF practices were sub-optimal and fell below accepted standards of ≥80%, except for the proportion of children 0-23 months who had ever breastfed, which was high (90.1%). Timely initiation of breastfeeding within the first hour of birth among children 0-23 months was 72.0%, with an estimated 60.9% of children 0-5 months being exclusively breastfed up to 6 months. The introduction of solid, semi-solid or soft foods at the age of six months was 57.9%. Only one-quarter (25.4%) of children aged 6-23 months met the minimum dietary diversity recommendation. The proportion of breastfed and non-breastfed children aged 6-23 months who met the minimum meal frequency was very low at 17.3%. A paltry 2.0% of children aged 6-23 months consumed the minimum acceptable diet.

The vast majority (84.7%) of the assessed women of reproductive age had a normal nutrition status (MUAC≥23). Only 13.4 percent were found to be at risk of malnutrition (MUAC>21-<23), while the remaining 1.9% were malnourished (MUAC<21).

The results of key indicators are summarized in table 1 below.

Table 1: Summary of survey results

Anthropometry - Children 6-59 months based on WHO 2006 standards				
Index	Indicator	N	n	Percent (95% C.I)
WHZ- scores	Prevalence of global acute malnutrition (<-2 z-score and/or oedema)	609	105	17.2% (13.8 - 21.3)
	Prevalence of moderate malnutrition (<-2 z-score and >=-3 z-score, no oedema)	609	84	13.8% (10.7 - 17.6)
	Prevalence of severe malnutrition (<-3 z-score and/or oedema)	609	21	3.4% (2.3 - 5.2)
MUAC children	Prevalence of global acute malnutrition (< 125 mm and/or oedema)	621	39	6.3 % (4.3 - 9.1)
	Prevalence of moderate acute malnutrition (< 125 mm and >= 110 mm, no oedema)	621	29	4.7 % (3.2 – 6.8)
	Prevalence of severe acute malnutrition (< 115 mm and/or oedema)	621	10	1.6 % (0.8 - 3.3)
WAZ- scores	Prevalence of underweight (<-2 z-score)	613	166	27.1% (22.9 – 31.7)
	Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	613	130	21.2% (17.7 - 25.2)
	Prevalence of severe underweight (<-3 z-score)	613	36	5.9% (4.2 – 8.1)
	Prevalence of stunting (<-2 z-score)	600	154	25.7% (22.0 – 29.7)

HAZ-scores	Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	600	114	19.0 % (16.3 – 22.0)
	Prevalence of severe stunting (<-3 z-score)	600	40	6.7% (4.7 - 9.4)
Retrospective Mortality - 100 days recall period				
Mortality	CDR Deaths/10,000 people/day	3248	34	0.37 (0.17 - 0.81)
	U5DR Deaths/10,000 children U5/day	632.5	12	0.32 (0.08 - 1.30)
Other child variables				
Measles vaccination	Measles immunization based on card	603	196	32.5% (28.7 - 36.5)
	Measles immunization based on recall	603	264	43.8% (40.0 - 47.8)
Morbidity				
	Prevalence of reported illness	621	231	37.2 (33.5 - 40.9)
Type of illness	Fever	231	76	32.9 (27.3 - 39.0)
	Cough		76	32.9 (27.3 - 39.0)
	Diarrhoea		25	10.8 (6.9 - 14.7)
	Other		120	51.9 (45.5 - 58.4)
Health seeking behavior				
Treatment sought	None	231	27	11.7 (7.4 - 15.6)
	Visited public health facility		112	48.5 (42.4 - 55.0)
	Visited private health facility		2	0.9 (0.0 - 2.2)
	Bought medicine from the pharmacy		72	31.2 (25.5 – 37.2)
	Other		18	7.8 (4.3 - 11.7)
Infant and young child feeding practices				
IYCF	Children ever breastfed (0-23.9 months)	243	219	90.1 (86.0 - 93.8)
	Early initiation of breastfeeding (0-23.9 months)	243	175	72.0 (66.7 - 77.4)
	Exclusive breastfeeding (0-5.9 months)	46	28	60.9 (45.7 - 73.9)
	Introduction of solid, semi-solid or soft foods (6-8.9 months)	19	11	57.9 (36.8 - 78.9)
	Minimum dietary diversity (6-23.9 months)	197	50	25.4 (19.8 - 32.0)
	Minimum meal frequency for both breastfed and non-breastfed (6-23.9 months)	197	34	17.3 (12.2 - 22.8)
	Minimum acceptable diet (6-23.9)	197	4	2.0 (0.5 - 4.1)
Maternal nutrition status				
MUAC women	MUAC <21cm	313	6	1.9 (0.6 - 3.5)
	MUAC >21 - <23cm		42	13.4 (9.9 - 16.9)
	MUAC ≥23cm		265	84.7 (80.8 - 88.2)

Specific recommendations are outlined below:

1. Survey findings show that the prevalence of GAM is well above the WHO emergency threshold. Tadamon is underserved by NGOs, and health and nutrition services in local health facilities are inadequate. Interviews with health officials from the state ministry of health based in Tadamon indicated that WFP and UNICEF regularly distribute RUSF and RUTF, but supplies are not adequate. The current nutrition interventions should be continued and scaled up to increase coverage. Both the outpatient therapeutic feeding program (OTP) and the targeted supplementary feeding program (TSFP) should be expanded to address the high caseload of GAM and SAM cases identified by the survey. Additionally, active case finding and referral of malnourished children to the nearest health facilities should be intensified.
2. To implement the recommendation to expand the nutrition program coverage in Tadamon, essential nutrition commodities need to be procured and distributed in a timely manner. Health officials in Tadamon as well as the respondents reported that therapeutic and supplementary foods and drugs are in short supply, and frequently beneficiaries go back home without supplies.
3. Total underweight and stunting prevalence were 27.1% and 25.7% respectively, and are considered to be of high public health significance. Given the irreversible negative impact of stunting on the growth and development of children, it is important to focus activities on children under the age of 2. In particular, more resources and efforts for stunting prevention should be availed. This requires the implementation of various multi-sectoral interventions that include but are not limited to the promotion of appropriate infant and young child feeding practices, providing micronutrient supplementation and deworming, and targeting mothers or caregivers with health messages on ways to diversify the household diet, the importance of seeking health services, and observing proper sanitation and hygiene practices.
4. According to survey results, more than one-third (37.2%) of children in Tadamon had suffered from a variety of illnesses. Treatment and prevention of childhood illnesses are urgently needed, but the primary health care centres in this area face challenges such as inadequate and inconsistent supplies, high disease caseloads, and staff shortages. This calls for additional resources to improve access and delivery of health services. For a start, partners can implement regular mobile health clinics and medical outreaches, and support local health facilities with essential medical supplies and recruitment of health workers.
5. Although most mothers and caregivers sought assistance when their children became ill, approximately one-third (31.2%) bought medicine from pharmacies, while 7.8% used alternative treatment options, which are practices that should be discouraged. Intensify community health education to sensitize community members to seek services from health facilities rather than self-medicate or rely on non-medical treatments.
6. Infant and young child feeding programs assessed in this survey were generally poor and fell below accepted standards. This necessitates continuous promotion of appropriate IYCF

practices through intensified health campaigns, regular nutrition education sessions targeting all family members, regular IYCF training for community health and nutrition volunteers, and using mother support groups to promote recommended IYCF practices, among other strategies.

7. While the survey found that most women of reproductive age had a normal nutritional status, several of the women were at risk of malnutrition or were already malnourished. This highlights the need to target these women with interventions, particularly during pregnancy and the lactation period to guarantee the best possible start for their children. Various approaches should be considered such as regular screening for malnutrition, enrolling and treating malnourished pregnant and lactating women, providing continuous health education on health-seeking during pregnancy, optimal child care and feeding practices, diet diversification, proper sanitation, and hygiene practices.
8. Conduct biannual pre-harvest and post-harvest SMART surveys to monitor the nutrition situation throughout the year. The current survey is the first successful nutrition assessment that was conducted in Tadamon, and the results will serve as a baseline for future reference.

1 Introduction

1.1 Background

Tadamon locality is one of the seventeen localities that make up the South Kordofan State in the Republic of Sudan. Tadamon borders Abassiya locality to the Northwest, Ar Rashad locality to the Southwest, Abu Jubeiha locality to the South, and White Nile State to the West.

According to the Sudan Humanitarian Needs Overview report of 2022, Tadamon locality has an estimated population of 84,588. The locality is inhabited by diverse Arab ethnic groups including the Hawzma, Kenana, Kawahla, Bagara, Falata, Takarir, and the African Nuba Logan tribes. The area also hosts internally displaced persons as well as the Dinka and Shilluk refugees from South Sudan. The main livelihood activities in Tadamon include pastoralism, small-scale agriculture, trading in livestock and farm products that are grown locally, primarily maize, sesame, and peanuts, as well as other imported goods from Khartoum. The main towns in Tadamon are Tartar and Wakara which also serve as the main commercial centres where most people purchase food and other household products.

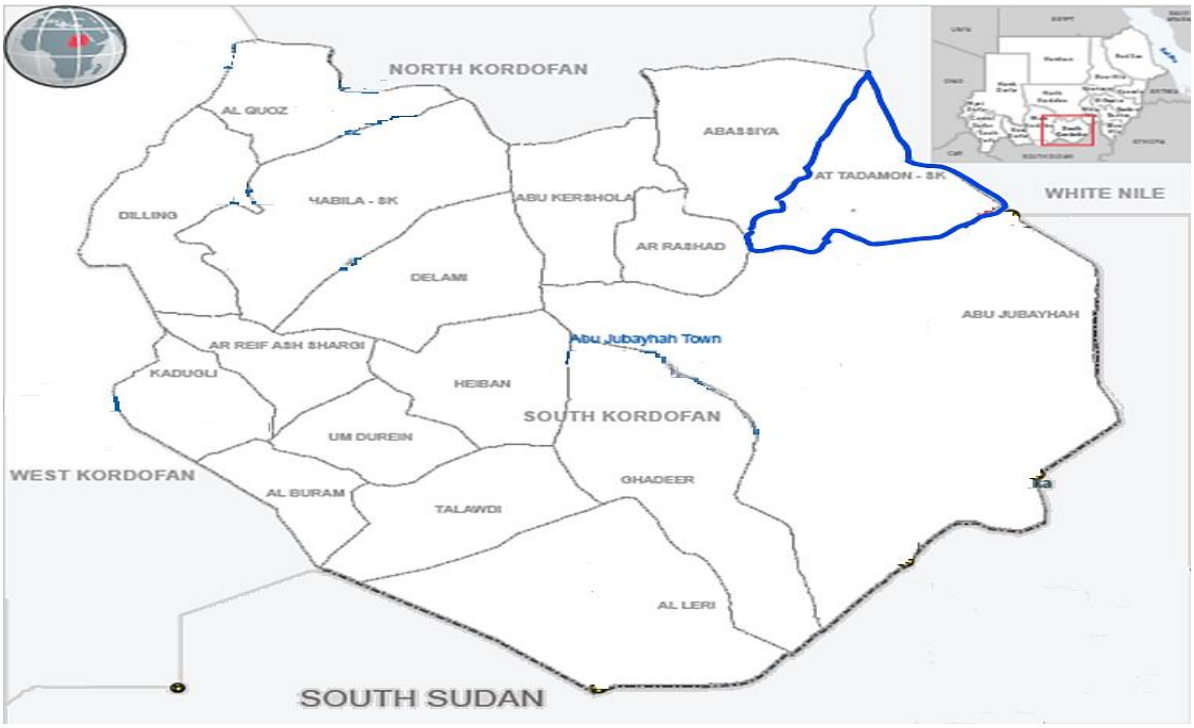

Figure 1: Map of South Kordofan State showing the location of Tadamon.

Tadamon locality is relatively stable but overall access to services is low. Due to its relative safety and fewer cases of insecurity, Tadamon has continued to receive internally displaced persons (IDPs) from other localities as well as refugees from the neighbouring South Sudan. Most IDPs live within host communities but they face high levels of food insecurity and limited access to health services such as education, clean water, and health care[1].

According to health officials in Tadamon, the area is served by one main hospital (Tartar hospital) and several primary health care centres spread across the entire locality. However, these health facilities face numerous challenges, ranging from inadequate and inconsistent supply of nutrition

[1] UNOCHA South Kordofan State profile March 2022

and medical commodities, high disease caseloads, and staff shortages. In addition, the area is underserved by NGOs with only three NGO's reportedly supporting health and nutrition activities but on a smaller scale and mostly targeting IDPs. These organizations include Save the Children, World Vision, and International Medical Corps.

Tadamon, like many other parts of South Kordofan, continues to face natural disasters including recurrent flooding during the rainy season, drought, and desertification. Moreover, acute and chronic food insecurity continues to threaten people's lives and livelihoods[2].

The food security situation in Tadamon is precarious. According to the IPC Sudan food security outlook update in May 2021, Tadamon was classified at IPC phase 3 (crisis level). Further, IPC classification projections for the period between October 2021 and February 2022 indicated that most parts of South Kordofan including Tadamon would remain in IPC phase 3. As per a joint rapid needs assessment by the Food and Agriculture Organization and several state governments in December 2021, South Kordofan was affected by dry spells and was likely to experience crop failure due to erratic and lower rainfall, with high agricultural input and production costs discouraging farmers from farming their lands, thus exacerbating an already precarious food security situation[3]. Based on this context, the main drivers of malnutrition in Tadamon are food insecurity, and lack of basic services.

To assess malnutrition prevalence in Tadamon locality, Action Against Hunger Spain conducted a post-harvest SMART survey to determine the nutritional status of children aged 6-59 months in April 2022.

1.2 Humanitarian assistance

There are several agencies currently working in Tadamon including WFP, UNICEF, Save the Children, World Vision, and IMC. These organizations were mainly supporting health and nutrition programs as indicated in table 2 below.

Table 2: Humanitarian agencies present in Tadamon

Organization	Sector
WFP	TSFP (RUSF distribution)
UNICEF	OTP (RUTF distribution)
Save the Children	Health and nutrition program
World Vision	Health and nutrition program
IMC	Health and nutrition program

[2] State Profile South Kordofan, UNICEF 2021
[3] UNOCHA Sudan Situation Report, March 2022

1.3 Survey Justification

The survey was required to assess the level of acute malnutrition among children aged 6-59 months in Tadamon locality. Results from the last S3M survey conducted in South Kordofan in 2018 are outdated and are unreliable as a source of information that can be used for planning and decision making. There had never been a SMART survey conducted in Tadamon, and this justified the need for a locality-specific survey. Additionally, there was a need to understand the current nutrition situation in the area to assist the government and other stakeholders in responding to the needs of the population by designing programs based on the survey findings.

1.4 Main objective of the survey

The overall objective of this survey was to determine the nutrition status of children aged 6-59 months as well as the mortality situation in Tadamon locality. The survey also assessed the probable factors contributing to malnutrition. The findings were used to propose recommendations to inform the humanitarian response in the area.

1.4.1 Specific Objectives

1. To determine the prevalence of acute malnutrition, stunting, and underweight among children aged 6-59 months.
2. To determine the retrospective crude mortality rate and the under-five mortality rate.
3. To assess the two-week retrospective childhood morbidity rate among children aged 6-59 months.
4. To understand the health seeking behaviors of the caretakers of children aged 6-59 months.
5. To assess the coverage of measles vaccination in children 9-59 months
6. To assess the nutritional status of women aged 15-49 years by MUAC measurement.
7. To assess the core infant and young child feeding practices among children aged 0-23 months.

1.5 Timing of the survey

The SMART Survey was conducted from April 17 to April 23, 2022 after the main harvest season as shown in the seasonal calendar below.

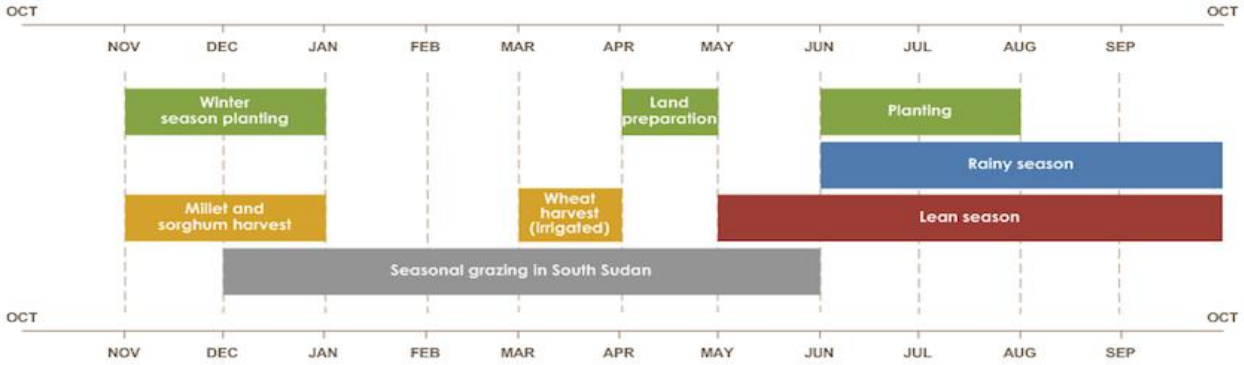

Figure 2: Sudan seasonal calendar

2 Methodology

2.1 Study design

The SMART survey employed a cross-sectional household survey design using the two-stage cluster sampling based on the SMART methodology. Clusters were selected using probability proportional to population size (PPS). Stage one sampling involved the sampling of clusters to be included in the survey while the second stage sampling involved the selection of households from the sampled clusters.

2.2 Study population

The target population for the anthropometric survey was children aged 6-59 months, while all households were targeted for retrospective mortality assessment. Mothers or caregivers were interviewed to obtain information on childhood morbidity, health-seeking behaviours, measles vaccination for children over the age of 9 months, and infant and young child feeding practices.

2.3 Sample size determination

The sample size was calculated using ENA for SMART software (January 11th, 2020 version). This was a combined survey that included both the anthropometry and mortality modules. Sample size calculation for anthropometry and mortality yielded two different household samples. The mortality sample was higher (534 households) than the anthropometry sample (464 households) and therefore the survey used the larger of the two samples (534) as the final sample size for the survey as recommended by the SMART survey guidelines[4]. The sample size of 534 households was subsequently adjusted slightly based on the calculation of the number of clusters which yielded 39 clusters and 14 HHs per cluster, which resulted in a total sample size of 546 HHs for the whole survey. However, after identifying the recall event, the recall period in days increased from the initial 93 days used for planning to 100 days. This led to a decrease in the mortality sample size from 546 HHs to 497 HHs.

For anthropometry, a total of 431 children in 464 households was calculated and for mortality, a total of 3248 persons was calculated.

The final sample size calculated for this survey was also used to assess infant and young child feeding practices. Information Data on infant and young child feeding practices (IYCF) was collected in all the 546 households with children 0-23 months to provide a snapshot of IYCF practices in the area. The results of the IYCF survey should however be interpreted and utilized cautiously due to the small sample sizes.

The calculation of sample sizes is shown in the tables below:

[4] SMART Methodology. *Updated SMART Manual Version 2.0 published in 2017.*

Table 3: Anthropometry sample size determination

Parameter	Values used	Rationale
Estimated prevalence %	20.1	Based on the CWW 2021 SMART Survey report in South Kordofan. A conservative estimate of 20.1% was used. Although the survey was conducted after the harvest season, this locality was largely unstable, with a population that is prone to food insecurity and service delivery being limited.
±desired precision %	4.5	According to the SMART methodology guideline.
Design effect	1.3	Based on the CWW SMART survey report 2021. A more conservative DEFF was considered due to the anticipated variability.
Average household size	6.4	As per the CWW SMART survey report 2021.
% of children under-five	17	Based on the national EPI estimate.
% of non-response households	5	Anticipated nonresponse rate.
Children to be included	**431**	Determined by ENA for SMART software using the above-given parameters.
Households to be included	**464**	Determined by ENA for SMART software based on the above-given parameters.

Table 4: Mortality sample size determination

Parameter	Values used	Rationale
Estimated death rate per 10000/day	0.5	As per the SMART methodology recommendation. There was no reliable information on CMR in the survey area.
±desired precision per 10000/day	0.3	Based on the SMART methodology guidelines.
Design effect	1.3	According to the SMART methodology guideline. A more conservative DEFF was used to cater for any variations.
Recall period in days	93	The default value was used. This was adjusted during training.
Average household size	6.4	Based on the CWW SMART survey report for 2021.
% of non-response households	5	Anticipated nonresponse rate.
Population to be included	**3248**	Determined by ENA for SMART software based on the above-given parameters.
Households to be included	**534**	Determined by ENA for SMART software based on the above-given parameters.

The sample size was met, and the survey reached 96.5% of planned households, while the number of children included in the survey was exceeded at 144.1%. The overachievement in the number of children suggests that the percentage of children under the age of five was underestimated, but this is consistent with the SMART methodology guidelines of choosing a lower estimate to avoid not getting enough children during the survey.

The percentage of nonresponse in this survey was 3.5%.

Achievement of sample size is shown in the table below:

Table 5: Percent of households and children 6-59 months included in the survey

Number of HHs planned	Number of HHs surveyed	% surveyed /planned	Number of children 6-59 months planned	Number of children 6-59 months surveyed	% surveyed /planned
546	527	96.5%	431	621	144.1%

2.4 Sampling methodology

The survey applied the two-stage cluster sampling based on the SMART methodology with clusters being selected using probability proportional to population size (PPS).

2.4.1 First stage sampling

The first stage entailed assigning the smallest sampling unit called clusters, which in this case were villages. A sampling frame for clusters (villages) with their respective population sizes was prepared with the assistance of local authorities in Tadamon. All the inhabited villages along with their respective populations were entered into the ENA for SMART software planning screen, which was used to select 39 clusters randomly based on PPS.

2.4.2 Second stage sampling

Simple random sampling was used to select 14 households per cluster to be surveyed. The household heads in the villages were listed with the support of the village Sheikhs. Once a complete list of household heads was obtained, enumerators used the random numbers tables to select the required number of households from the household list which comprised the sampling frame in the second stage of sampling at the household level.

2.4.3 Number of households per cluster

The number of households to be completed per day was determined according to the time the team could spend in the field excluding transportation, other procedures, and break times.

The details below are taken into consideration when performing this calculation based on the given context:

1. Departure from office at 7:30 am and back at 5:30 pm.
2. Average travel time to reach each cluster (to and from the field): 2 hrs.
3. Duration for initial introduction and selection of households: 1 hour.
4. Break: one lunch break of 1 hour.

The above gave an average of 6 hours of working time in each cluster. It was determined that on average, teams could spend 20 minutes in each household and 5 minutes moving from one HH to another, which would allow each team to comfortably reach 14 HHs per day. The total number of households in the sample was then divided by the number of households to be completed in one day to determine the number of clusters to be included in the survey. Based on this calculation, 39 clusters (534 HH/14 HH per day = 38.1 rounded up to 39) were selected to be included in the survey.

Out of 118 villages, 39 villages, corresponding to 39 clusters were included in the survey.

2.5 Survey implementation

2.5.1 Survey management and coordination

The survey protocol was developed and discussed with Action Against Hunger staff in charge of survey implementation before being presented to the Nutrition Information Technical Working Group (NIS TWG) for validation. The survey was managed by a consultant from Action Against Hunger Canada. The consultant also led the fieldwork and was overall responsible for survey implementation at the field level.

Relevant information on security and access was obtained before the survey from the South Kordofan State government and the Tadamon locality administration. Meetings were held with local leaders on arrival to brief them on the survey objectives, methodology, and procedures to be followed during the survey. In addition, village-level population was obtained from the local authorities in Tadamon.

2.5.2 Training, data collection, supervision, and data quality

2.5.2.1 Survey teams' training and data collection

The survey teams were trained on the SMART methodology for five days from 1st to 5th April 2022. To manage the logistical and financial resources available to the implementing agency, joint training of two separate survey teams for Tadamon and Ghadeer localities was conducted in Abu Jubeiha locality. The survey manager delivered the training in English, but the content was translated by Action Against Hunger M&E Officer with assistance from four survey supervisors from the federal ministry of health, UNICEF, WHO, and Muslim Aid agency. The training focused on the survey objectives, sampling methodology and field procedures, anthropometric measurements, use of the event calendar, administration of the survey questionnaire in a digital format, and interviewing techniques.

On the third day of training, two standardization tests were carried out simultaneously in a large compound within the main health facility in Abu Jubeiha locality that also housed the training hall. The two standardization tests were used to evaluate the accuracy and precision of the team members in taking anthropometric measurements. Both teams Tadamon and Ghadeer performed well in the test. The standardization test results for Tadamon are shown in annex 3 of

this survey report. The survey questionnaire was pre-tested as part of the training of enumerators in two separate villages of Abu Jubeiha locality.

Data collection in Tadamon was conducted between 7th to 13th April 2022. Six teams participated in the survey in Tadamon, with each team comprising three members (1 team leader and 2 enumerators).

Data was collected offline using the KoBo Toolbox application because the telephone network in Tadamon was limited and unreliable, making it impossible to upload data to a configured server. As a result, anthropometric data were also recorded on paper forms to allow for daily plausibility checks of the data to determine its quality and give feedback to the teams every morning before going to the field.

All the 39 randomly chosen clusters were surveyed. Data collection in three (clusters 1, 3, and 5) was repeated on the final day of the survey owing to the poor quality of data that had been collected on the first day from these clusters.

2.5.2.2 Survey teams' supervision

At the field level, close supportive supervision by the consultant, the AAH M&E Officer, and three dedicated supervisors from the federal ministry of health, UNICEF, and Muslim Aid organization ensured that the data collected was of high quality. Any mistakes that were noted during data collection were corrected and teams were given prompt feedback.

2.5.2.3 Data quality assurance

Several measures were employed to ensure quality data including:

- Use of the KoBo Toolbox application for digital data collection to minimize the possibility of errors when recording data.
- A five-day comprehensive training together with standardization test and field pretest.
- Field supervision of the survey teams during data collection.
- Calibration and standardization of survey equipment.
- Use of the cluster control forms to track the assessment outcome for every household.
- Daily plausibility checks and sharing of feedback with the teams for continuous improvement as data collection progressed.
- Repeating data collection in three clusters that had poor data quality, with the affected teams getting direct support and increased supervision.

2.5.3 Data collection tools

Structured questionnaires were used to collect quantitative data. Data was collected using the KoBo Toolbox digital application. Data collection tools included: Mortality questionnaire (targeting all households), anthropometric questionnaire (targeting children 6-59 months), and infant and young child feeding questionnaire (targeting mothers/caregivers).

All questionnaires used were the standard SMART survey data collection tools recommended by the SMART global team at Action Against Hunger Canada as well as the NIS TWG (Appendix 4).

2.6 Data collected

In the selected households, all children 6-59 months were included in the anthropometric survey. The age of the children was determined using birth certificates where available and a local calendar of events for children without birth certificates. If there were no children 6-59 months in the household, the household was still interviewed for mortality. All survey data were collected by recall.

The following case definitions were used in the assessment:

2.6.1 Mortality

Retrospective mortality data were collected in all the visited households, including those with no children aged 6-59 months. A recall period of 100 days was used.

Individual mortality questionnaire was used to collect the following data:

- Total number of people in the household
- Number of children under five years
- Number of people who left the household within the recall period (total and children under five years)
- Number of people who joined the household within the recall period (total and children under five years)
- Number of births in the household within the recall period
- Number of deaths in the household within the recall period (total and children under five years)
- Cause of deaths

2.6.2 Individual information per survey child - Anthropometry

Age: The primary source for this information was the child's birth certificate or birth notification. In the absence of these documents, a local calendar of events was used to estimate the age (Appendix 5).

Gender/Sex: This was recorded as either 'f' for female or 'm' for male.

Weight: A digital weighing scale (SECA) was used to measure children's weight. Children were weighed with minimal or no clothing and weight was recorded to the nearest 0.1kg.

The teams on daily basis calibrated the electronic scales using a standard weight to ensure accuracy.

Height/Length: This was measured using a standard UNICEF height/length board – taking a standing height for children 24-59 months (or >87 cm) and recumbent length for children 6-23

months (or <87 cm). Both height and length were measured to the nearest 0.1 cm. Measurement was done by a measurer and recorded with assistance from the child's mother/caretaker.

MUAC: Mid Upper Arm Circumference was measured on the left arm at the middle point between the tip of the elbow and the tip of the shoulder bone while the arm was at right-angle. MUAC was measured to the nearest mm. In the event of a disability on the left arm or a left-handed child, the right arm was used.

Bilateral Oedema: This was assessed by the application of moderate thumb pressure for at least 3 seconds on both feet. If a depression formed upon pressure application, the presence of bilateral oedema was confirmed.

2.6.3 Individual information per survey child – Child health

Measles immunization: Assessed by checking for measles vaccination on EPI cards or by recall and was only done for eligible children (≥ 9 months)

Child morbidity and health-seeking: Two-week retrospective morbidity data were collected from mothers or caregivers of all children (6-59 months) included in the anthropometric survey. The mother or caregiver was asked if the child had been ill in the past two weeks and if so, they were then asked the type of illness and treatment sought.

2.6.4 Individual information per survey child – Infant and Young Child Feeding practices

Infant and young child feeding practices were assessed based on the standard WHO recommendations (WHO, 2010) as follows:

Ever breastfed: Proportion of children born in the last 24 months who were ever breastfed.

$$\frac{\textit{Children born in the last 24 months who were ever breastfed}}{\textit{Children born in the last 24 months}}$$

Early initiation of breastfeeding: Proportion of children born in the last 23 months who are put to the breast within one hour of birth.

$$\frac{\textit{Children 0-23 months who were put to the breast within one hour of birth}}{\textit{Children 0-23 months}}$$

Exclusive breastfeeding under 6 months: Proportion of infants 0–5 months of age who are fed exclusively with breast milk a day before the survey date.

$$\frac{\textit{Infants 0–5 months of age who received only breast milk during the previous day}}{\textit{Infants 0–5 months of age}}$$

Introduction of solid, semi-solid or soft foods: Proportion of infants 6–8 months of age who received solid, semi-solid or soft foods.

$$\frac{\textit{Infants 6-8 months of age who received solid, semi-solid or soft foods during the previous day}}{\textit{Infants 6–8 months of age}}$$

Minimum dietary diversity: Proportion of children 6–23 months of age who received foods from ≥ 4 food groups during the previous day.

$$\frac{\textit{Children 6–23 months of age who received foods from} \geq \textit{4 food groups during the previous day}}{\textit{Children 6–23 months of age}}$$

Minimum meal frequency: Proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more.

$$\frac{\textit{Breastfed and non-breastfed children 6–23 months of age who received solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more during the previous day}}{\textit{Children 6-23 months of age}}$$

Minimum acceptable diet: Proportion of children 6–23 months of age who receive a minimum acceptable diet (apart from breast milk).

$$\frac{\textit{Breastfed children 6–23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day}}{\textit{Breastfed children 6-23 months of age}}$$

and

$$\frac{\textit{Non-breastfed children 6–23 months of age who received at least 2 milk feedings and had at least the minimum dietary diversity not including milk feeds and the minimum meal frequency during the previous day}}{\textit{Non-breastfed children 6-23 months of age}}$$

2.6.5 Maternal nutritional status

The nutritional status of women of reproductive age was assessed by measuring the mid-upper arm circumference.

2.7 Data entry, analysis, and report writing

After completing data collection in Tadamon, data was uploaded to a configured server where it was retrieved and analyzed. Anthropometric data were analyzed using ENA for SMART software January 11th, 2020 version. Additional survey data were analyzed using SPSS version 26 and Excel.

2.8 Classifying malnutrition

2.8.1 Weight for height (WFH) and MUAC – Wasting among children

The prevalence of wasting is presented as global acute malnutrition (GAM) and severe acute malnutrition (SAM) using weight-for-height (WFH) Z- scores and MUAC indices described below:

- Children whose WFH Z-scores fell below -2 standard deviations from the median of the WHO growth standards or had bilateral oedema were classified as wasted (to reflect GAM).
- Children whose WFH Z-scores fell below -3 standard deviations from the median of the WHO growth standards or had bilateral oedema were classified as severely wasted (to reflect SAM).
- A cut-off point of <125mm MUAC was used to denote GAM among the under-fives.

2.8.2 Weight for age (WFA) – Underweight

The prevalence of underweight is presented as weight for age (WFA) Z scores defined below:

- Children whose WFA Z-scores fell below -2 standard deviations from the median of the WHO growth standards were classified as underweight.
- Children whose WFA Z-scores fell below -3 standard deviations from the median of the WHO growth standards were classified as severely underweight.

2.8.3 Height for age (HFA) – Stunting

The prevalence of stunting is presented as height-for-age (HFA) Z scores defined below:

- Children whose HFA Z-scores fell below -2 standard deviations from the median of the WHO growth standards were classified as stunted.
- Children whose HFA Z-scores fell below -3 standard deviations from the median of the WHO growth standards were classified as severely stunted.

2.9 Results dissemination

The consultant prepared and shared a final draft report in MS Word accompanied by ENA and Excel data sets. Final survey documents and reports were submitted to Action Against Hunger Spain after incorporating feedback given and for circulation.

2.10 Possible bias and assumptions

Recall bias, as well as the intentional exclusion of some children, could have occurred. 99% of the children did not have records indicating birth dates.

Anthropometric measurements are prone to measurement errors. To minimize errors, survey teams were adequately trained on measurement techniques and standardization test carried out to improve the accuracy and precision of measurements.

Causes of death should also be interpreted cautiously because they were reported by family members based on observation, with no verification of the clinical cause of death.

To further mitigate against potential biases, questions were translated from English to Arabic, and the questionnaire was refined through pretesting.

Nearly all the participants did not speak or understand English. During training and fieldwork, the survey manager relied heavily on the translator to present information. This may have led to information distortion and an inability to understand the technical content presented in the training by some enumerators. Also, some surveyors were unable to follow instructions during data collection, potentially affecting survey results.

2.11 Ethical considerations

Participation in the survey was voluntary. Verbal consent was sought from all respondents (mothers and caregivers of children) before starting the interview.

Children were weighed naked if the mother or caregiver gave the authorization, if not weighing was done with the minimum possible clothing.

Mothers and/or caregivers of moderately and severely acutely malnourished children (assessed with Weight-for-Height or with MUAC) were informed of their condition and a referral slip to the nearest nutrition site was provided.

3 Survey results

3.1 Anthropometric results (based on WHO standards 2006)

3.1.1 Distribution by age and sex

To determine the nutritional status in Tadamon locality, 621 children (313 boys and 308 girls) aged 6-59 months were measured. The distribution of the assessed children by age and sex shows that boys and girls were equally represented with a ratio of 1.0.

The age ratio of 6-29 months to 30-59 months was 1.02 (The value should be around 0.85) which was statistically significant (p-value = 0.026). The older age category (54-59 months) is underrepresented compared to younger children. The under-representation of the older children (54-59 months) was as a result of their absence in the households during the survey owing to a number of these children attending Madrasa (religious school) or participating in family livelihood activities such as farming, herding, water collection, and others.

Distribution of age and sex is shown in Table 6 below.

Table 6: Distribution of age and sex of the sample

	Boys		Girls		Total		Ratio
AGE (mo)	**no.**	**%**	**no.**	**%**	**no.**	**%**	**Boy:girl**
6-17	71	52.6	64	47.4	135	21.7	1.1
18-29	94	52.8	84	47.2	178	28.7	1.1
30-41	70	49.6	71	50.4	141	22.7	1.0
42-53	61	50.4	60	49.6	121	19.5	1.0
54-59	17	37.0	29	63.0	46	7.4	0.6
Total	313	50.4	308	49.6	621	100.0	1.0

3.1.2 Prevalence of acute malnutrition based on Weight for Height and by sex

The prevalence of Global Acute Malnutrition (GAM) in Tadamon locality was 17.2**%** (13.8 – 21.3 95% C.I.), and the severe acute malnutrition (SAM) rate was 3.4% (2.3 – 5.2 95% C.I.). GAM prevalence indicates a critical nutrition situation according to the WHO classification of acute malnutrition. Similarly, the prevalence of SAM is high based on routine acute malnutrition screening data by NGOs that implement nutrition programs, since there are no defined prevalence cutoffs for SAM.

There was no statistically significant difference in the prevalence of GAM between boys and girls (p-value = 0.1497).

Table 7: Prevalence of acute malnutrition based on weight-for-height Z-scores and/or oedema by sex

	All n = 609	Boys n = 306	Girls n = 303
Prevalence of global malnutrition (<-2 z-score and/or oedema)	(105) 17.2 % (13.8 - 21.3 95% C.I.)	(61) 19.9 % (15.3 - 25.5 95% C.I.)	(44) 14.5 % (10.7 - 19.4 95% C.I.)
Prevalence of moderate malnutrition (<-2 z-score and >=-3 z-score, no oedema)	(84) 13.8 % (10.7 - 17.6 95% C.I.)	(47) 15.4 % (11.1 - 20.8 95% C.I.)	(37) 12.2 % (8.7 - 16.9 95% C.I.)
Prevalence of severe malnutrition (<-3 z-score and/or oedema)	(21) 3.4 % (2.3 - 5.2 95% C.I.)	(14) 4.6 % (2.6 - 7.8 95% C.I.)	(7) 2.3 % (1.2 - 4.5 95% C.I.)

There was no case of oedema reported in this survey.

The distribution of weight-for-height z-scores for the survey data falls to the left of the reference curve, with a mean of -1.10 and SD of ±0.96. This indicates that the nutrition status of children in Tadamon is poor compared to the WHO reference population. The standard deviation of ±0.96 is within the acceptable range of 0.8 to 1.2. The calculated design effect (DEFF) was 1.48 which shows there were some inter-cluster differences.

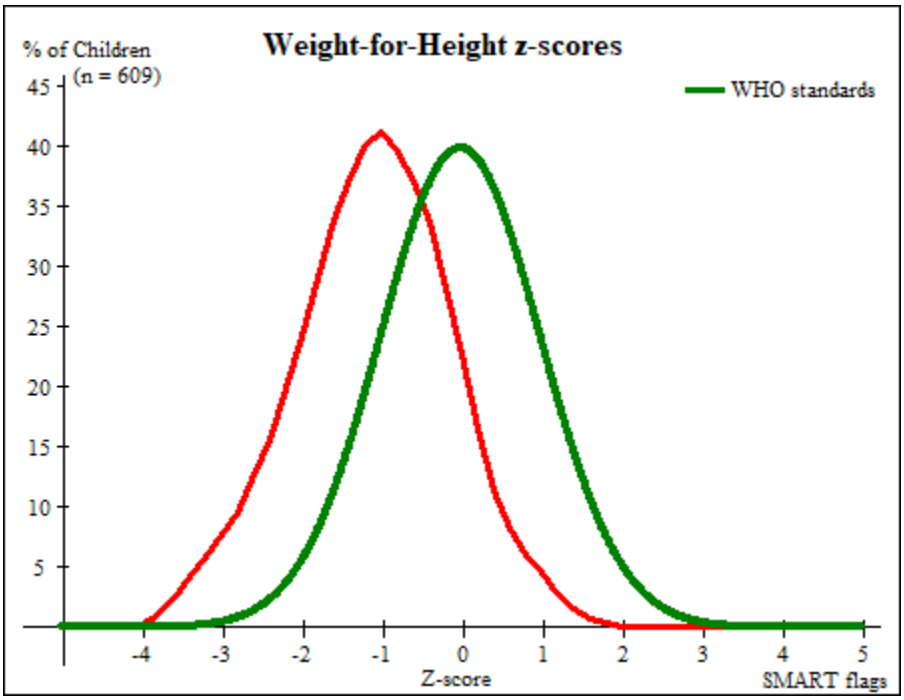

Figure 3: Frequency Distribution of WFH Z-scores for children 6-59 months

3.1.3 Prevalence of acute malnutrition by age based on Weight for Height

The prevalence of acute malnutrition (WHZ<-2 and/or oedema) by age shows that younger children in the age categories 6-17 and 18-29 months were more affected by both severe and moderate wasting compared to the older age groups.

Table 8: Prevalence of acute malnutrition by age based on weight-for-height Z-scores and/or oedema

		Severe wasting (<-3 z-score)		Moderate wasting (>= -3 and <-2 z-score)		Normal (> = -2 z score)		Oedema	
Age (mo)	**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-17	133	7	5.3	22	16.5	104	78.2	0	0.0
18-29	170	5	2.9	20	11.8	145	85.3	0	0.0
30-41	140	3	2.1	16	11.4	121	86.4	0	0.0
42-53	120	4	3.3	16	13.3	100	83.3	0	0.0
54-59	46	2	4.3	10	21.7	34	73.9	0	0.0
Total	609	21	3.4	84	13.8	504	82.8	0	0.0

3.1.4 Distribution of acute malnutrition and oedema based on WFH Z-scores

In this survey, no case of oedema was identified, but there were 20 marasmic cases (severe wasting) with no oedema as indicated in Table 9 below.

Table 9: Distribution of acute malnutrition and oedema based on WFH Z-scores

	<-3 z-score	>=-3 z-score
Oedema present	Marasmic kwashiorkor. 0 (0.0 %)	Kwashiorkor. 0 (0.0 %)
Oedema absent	Marasmic No. 28 (4.5 %)	Not severely malnourished. 593 (95.5 %)

3.1.5 Prevalence of acute malnutrition based on MUAC cut off's and/or oedema by sex

The prevalence of GAM based on MUAC <125 mm and/or oedema was 6.3 % (4.3 – 9.1 95% C.I.), while SAM based on MUAC<115 mm and/or oedema was 1.6 % (0.8 – 3.3 95% C.I.). GAM prevalence by MUAC was significantly lower compared to GAM prevalence by Weight for Height Z-scores. Generally, MUAC usually tends to indicate lower GAM compared with WFH Z-scores. Previous research on the differences between wasting measured by weight-for-height and by MUAC has shown remarkable differences between the two measurements as a result of

variations in the body shape, age, and gender in many surveyed populations, which is why the use of both criteria in anthropometric surveys is recommended[5].

Table 10: Prevalence of acute malnutrition based on MUAC cut off's and/or oedema by sex

	All n = 621	Boys n = 313	Girls n = 308
Prevalence of global malnutrition (< 125 mm and/or oedema)	(39) 6.3 % (4.3 - 9.1 95% C.I.)	(17) 5.4 % (3.0 - 9.5 95% C.I.)	(22) 7.1 % (4.8 - 10.5 95% C.I.)
Prevalence of moderate malnutrition (< 125 mm and >= 115 mm, no oedema)	(29) 4.7 % (3.2 - 6.8 95% C.I.)	(14) 4.5 % (2.5 - 7.8 95% C.I.)	(15) 4.9 % (3.2 - 7.4 95% C.I.)
Prevalence of severe malnutrition (< 115 mm and/or oedema)	(10) 1.6 % (0.8 - 3.3 95% C.I.)	(3) 1.0 % (0.3 - 2.9 95% C.I.)	(7) 2.3 % (1.0 - 5.0 95% C.I.)

3.1.6 Prevalence of acute malnutrition by age based on MUAC cut off's and/or oedema

Similarly, as seen with the prevalence of wasting based on weight-for-height by age, younger children 6-17 and 18-29 months were more affected by both severe and moderate acute malnutrition based on MUAC (cut-offs >115 mm and < 125 mm respectively). This could be attributed to poor child care and feeding practices among these children.

Table 11: Prevalence of acute malnutrition by age based on MUAC cut off's and/or oedema

		Severe wasting (< 115 mm)		Moderate wasting (>= 115 mm and < 125 mm)		Normal (> = 125 mm)		Oedema	
Age (mo)	**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-17	135	6	4.4	18	13.3	111	82.2	0	0.0
18-29	178	4	2.2	8	4.5	166	93.3	0	0.0
30-41	141	0	0.0	2	1.4	139	98.6	0	0.0
42-53	121	0	0.0	1	0.8	120	99.2	0	0.0
54-59	46	0	0.0	0	0.0	46	100.0	0	0.0
Total	621	10	1.6	29	4.7	582	93.7	0	0.0

[5] Weight-for-height and mid-upper-arm circumference should be used independently to diagnose acute malnutrition: policy implications. Grellety and Golden BMC Nutrition (2016).

3.1.7 Prevalence of combined GAM and SAM based on WHZ and MUAC cut off's (and/or oedema) and by sex

The survey shows that the combined GAM and SAM among children 6-59 months in Tadamon was 19.6% (15.9-24.0 95% CI). Higher prevalence was recorded when using the combined GAM and SAM prevalence compared to the prevalence observed using WHZ or MUAC independently. This suggests that the combined GAM and MUAC indicator is useful in identifying more children who are acutely malnourished.

Table 12: Prevalence of combined GAM and SAM based on WHZ and MUAC cut off's (and/or oedema) and by sex*

	All n = 621	Boys n = 313	Girls n = 308
Prevalence of combined GAM (WHZ <-2 and/or MUAC < 125 mm and/or oedema)	(122) 19.6 % (15.9 - 24.0 95% C.I.)	(67) 21.4 % (16.6 - 27.2 95% C.I.)	(55) 17.9 % (13.8 - 22.8 95% C.I.)
Prevalence of combined SAM (WHZ < -3 and/or MUAC < 115 mm and/or oedema	(26) 4.2 % (2.8 - 6.3 95% C.I.)	(14) 4.5 % (2.6 - 7.6 95% C.I.)	(12) 3.9 % (2.2 - 6.9 95% C.I.)

*With SMART or WHO flags a missing MUAC/WHZ or not plausible WHZ value is considered as normal when the other value is available

3.1.8 Prevalence of underweight based on weight for age Z scores by sex

The observed underweight prevalence among the assessed children was 27.1% (22.9 – 31.7 95% C.I.) with 5.9% (4.2 – 8.1 95% C.I.) having severe underweight. The underweight prevalence is classified as high as per the WHO underweight threshold[6].

The rate of underweight among boys was 28.6% (22.7-35.3 95% C.I.) and was marginally higher than the underweight rate seen among girls of 25.6% (20.4-31.5 95% C.I.). However, there was no statistically significant difference in underweight between boys and girls (p-value = 0.4940).

Table 13: Prevalence of underweight based on weight-for-age Z-scores by sex

	All n = 613	Boys n = 308	Girls n = 305
Prevalence of underweight (<-2 z-score)	(166) 27.1 % (22.9 - 31.7 95% C.I.)	(88) 28.6 % (22.7 - 35.3 95% C.I.)	(78) 25.6 % (20.4 - 31.5 95% C.I.)
Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	(130) 21.2 % (17.7 - 25.2 95% C.I.)	(71) 23.1 % (17.5 - 29.7 95% C.I.)	(59) 19.3 % (14.9 - 24.8 95% C.I.)
Prevalence of severe underweight (<-3 z-score)	(36) 5.9 % (4.2 - 8.1 95% C.I.)	(17) 5.5 % (3.5 - 8.6 95% C.I.)	(19) 6.2 % (4.1 - 9.3 95% C.I.)

[6] Nutrition Landscape Information System (NLiS) country profile indicators 2019

3.1.9 Prevalence of underweight by age based on weight for age Z scores

There were slightly more cases of both severe and moderate underweight identified in the age groups 6-17 and 18-29 months. This means that younger children were more vulnerable to severe and moderate underweight than older children.

Table 14: Prevalence of underweight based on weight-for-age Z-scores by age

		Severe underweight (<-3 z-score)		Moderate underweight (>= -3 and <-2 z-score)		Normal (> = -2 z score)		Oedema	
Age (mo)	**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-17	134	9	6.7	31	23.1	94	70.1	0	0.0
18-29	171	18	10.5	40	23.4	113	66.1	0	0.0
30-41	141	4	2.8	25	17.7	112	79.4	0	0.0
42-53	121	3	2.5	26	21.5	92	76.0	0	0.0
54-59	46	2	4.3	8	17.4	36	78.3	0	0.0
Total	613	36	5.9	130	21.2	447	72.9	0	0.0

3.1.10 Prevalence of stunting based on height for age Z scores

The overall prevalence of stunting in Tadamon was 25.7% (22.0-29.7 95% C.I.) and severe stunting was 6.7% (4.7-9.4 95% C.I.). This is classified as high according to the WHO classification[7]. Boys were slightly more stunted at 27.3% (22.3-33.0 95% C.I.) than girls at 24.0% (19.5.-29.2) but this difference in stunting by gender was not statistically significant (p value= 0.3843).

Table 15: Prevalence of stunting based on height-for-age z-scores and by sex

	All n = 600	**Boys** n = 300	**Girls** n = 300
Prevalence of stunting (<-2 z-score)	(154) 25.7 % (22.0 - 29.7 95% C.I.)	(82) 27.3 % (22.3 - 33.0 95% C.I.)	(72) 24.0 % (19.5 - 29.2 95% C.I.)
Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	(114) 19.0 % (16.3 - 22.0 95% C.I.)	(60) 20.0 % (15.8 - 25.0 95% C.I.)	(54) 18.0 % (14.0 - 22.8 95% C.I.)
Prevalence of severe stunting (<-3 z-score)	(40) 6.7 % (4.7 - 9.4 95% C.I.)	(22) 7.3 % (4.6 - 11.5 95% C.I.)	(18) 6.0 % (4.0 - 8.9 95% C.I.)

[7] Nutrition Landscape Information System (NLiS) country profile indicators 2019

The prevalence of stunting by age shows that children in the age categories 18-29 and 30-41 had more cases of severe and moderate stunting, while children aged 42-53 months only had moderate stunting. According to research, the odds of stunting increase with age because as children grow older, their feeding and other care practices tend to deteriorate[8].

Table 16: Prevalence of stunting by age based on height-for-age z-scores

		Severe stunting (<-3 z-score)		Moderate stunting (>= -3 and <-2 z-score)		Normal (> = -2 z score)	
Age (mo)	**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-17	133	8	6.0	17	12.8	108	81.2
18-29	167	16	9.6	48	28.7	103	61.7
30-41	135	11	8.1	23	17.0	101	74.8
42-53	119	4	3.4	22	18.5	93	78.2
54-59	46	1	2.2	4	8.7	41	89.1
Total	600	40	6.7	114	19.0	446	74.3

3.1.11 Mean Z-scores, design effects, and excluded subjects

The mean Z scores for wasting (WHZ), underweight (WAZ), and stunting (HAZ) were; -1.10±0.96, -1.42±0.97, and -1.21±1.18 respectively, all indicating the nutrition situation was poor compared to the WHO reference population. The three nutrition indicators including WHZ, WAZ, and HAZ had standard deviations that were within the acceptable range of 0.8-1.2, indicating that the survey data was of high quality. The sample design effect values of 1.48 for WHZ and 1.48 for WAZ showed some inter-cluster variability. However, the DEFF value of 1.12 for HAZ indicated there were inter-cluster variations in stunting.

Table 17: Mean Z-scores, Design Effects and excluded subjects

Indicator	n	Mean z-scores ± SD	Design Effect (z-score < -2)	z-scores not available*	z-scores out of range
Weight-for-Height	609	-1.10±0.96	1.48	0	12
Weight-for-Age	613	-1.42±0.97	1.48	0	8
Height-for-Age	600	-1.21±1.18	1.12	0	21

* contains for WHZ and WAZ the children with oedema.

[8] Reducing stunting in children - UNICEF 2015

3.2 Demography and mortality results (retrospective over 100 days prior to interview)

3.2.1 Age and sex pyramid

The overall male to female sex ratio was 0.91. There are only minor differences in the male to female sex ratio, with those above 65 years having a much higher male to female sex ratio (1.45). Individuals aged 18-49 years old made up one-third (34.5%) of the surveyed population. The population pyramid shows noticeable indents for both males and females in the age groups 30-34 and 40-44, which could be attributed to a higher rate of out-migration compared to in-migration. Females make up a larger proportion of the population (52.3%) than males (47.7%). The percentage of children under five was 20%.

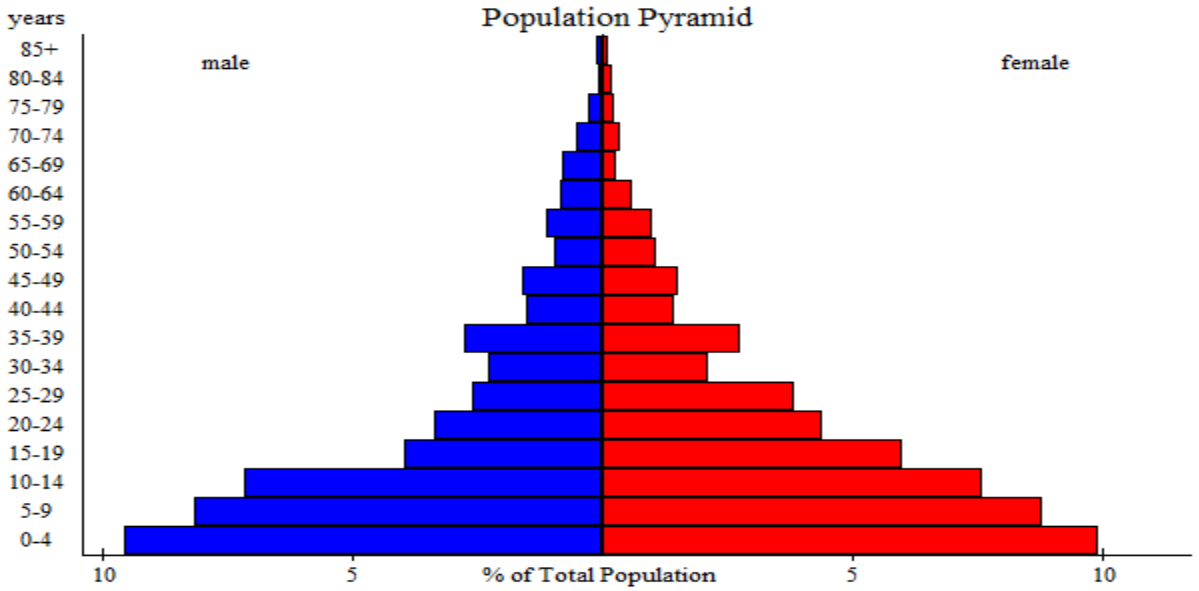

Figure 4: Population Pyramid of Tadamon locality

Mortality data was collected using the mortality individual questionnaire. The survey revealed a death rate of 0.37 (0.17-0.82) per day among the adult population, while the under-five mortality rate was 0.32 (0.08-1.32) as reported in the previous 100 days. Both the CDR and the U5DR were below the WHO emergency thresholds of 1/10,000/day and 2/10,000/day respectively.

Most deaths were as a result of illness (75.0%) while 25% of the reported deaths were due to unknown causes. All the reported deaths occurred in the current location which were the surveyed households.

Mortality results are presented in table 18 below.

Table 18: Demographic profile of the respondents in Tadamon

Parameters for Mortality		Results (C.I 95%)	
CMR (deaths per 10 000/day		0.37 (0.17-0.81 95% CI)	
U5MR (deaths in children <5/10 000/day		0.32 (0.08-1.30 95%)	
Persons recorded within the recall period		3237.5	
Current residents <5 years old		622	
Total deaths during the recall period		12	
Total deaths during the recall period <5 years old		2	
Recall Period (days)		100	
Population to be included		3248	
Average HH Size		6.2	
Households to be included		546	
Percentage of children under 5		19.9	
Birth rate		0.2	
In-migration rate (Joined)		4.02	
Out-migration rate (Left)		5.25	
Cause of death	**%**	**Location of death**	**%**
1. Unknown	25.0	1] In current location	100.0
2. Injury/traumatic	0.0	2] During migration	0.0
3. Illness	75.0	3] In the place where person migrated	0.0
		4] Other	0.0

4 Other results

4.1 Measles immunization

Measles immunization coverage was assessed among children 9 to 59 months. The proportion of children immunized against measles confirmed by checking EPI cards was (32.5%), while children vaccinated based on mother's recall was 43.8%. The overall coverage of measles vaccine based on both card and recall was 76.3% which was below the WHO target coverage of ≥80%.

Table 19: Measles vaccine coverage

Indicator	N	n	Proportion (95% C.I)
Children 9-59 months immunized against measles, based on card	603	196	32.5 (28.7-36.5)
Children 9-59 months immunized against measles, based on recall	603	264	43.8 (40.0-47.8)

4.2 Morbidity status

To assess child morbidity, mothers or caregivers of children aged 6-59 months were asked if their children had been sick in the two weeks before the survey. Over one-third (37.2%) of the children had experienced illness two weeks before the survey. The three most common childhood illnesses showed the following rates: fever (32.9%), Cough (32.9%), and diarrhea (10.8%). Other common illnesses that affected children in Tadamon were malaria, vomiting, eye infection, ear infection, tonsilitis, and a few others.

Table 20: Morbidity among children two weeks before the survey

Indicator	N	n	Proportion (95% C.I)
Prevalence of reported illness	621	231	37.2 (33.5-40.9)
Fever	231	76	32.9 (27.3-39.0)
Cough		76	32.9 (27.3-39.0)
Diarrhea		25	10.8 (6.9-14.7)
Other		120	51.9 (45.5-58.4)

4.2.1 Health seeking behaviour

Mothers and caregivers who reported that their children had been ill in the 2 weeks that preceded the survey were asked if they sought any assistance. Findings revealed that an estimated 48.5% of the caregivers sought treatment from public health facilities, 0.9% visited private health facilities, 31.2% bought medicine from pharmacies, 7.8% tried alternative treatment, and 11.7% did not seek treatment. It's worth noting that nearly one-third (31.2%) of caregivers bought medicine from the pharmacy, while 7.8% said they visited traditional healers or borrowed medicine from their neighbors.

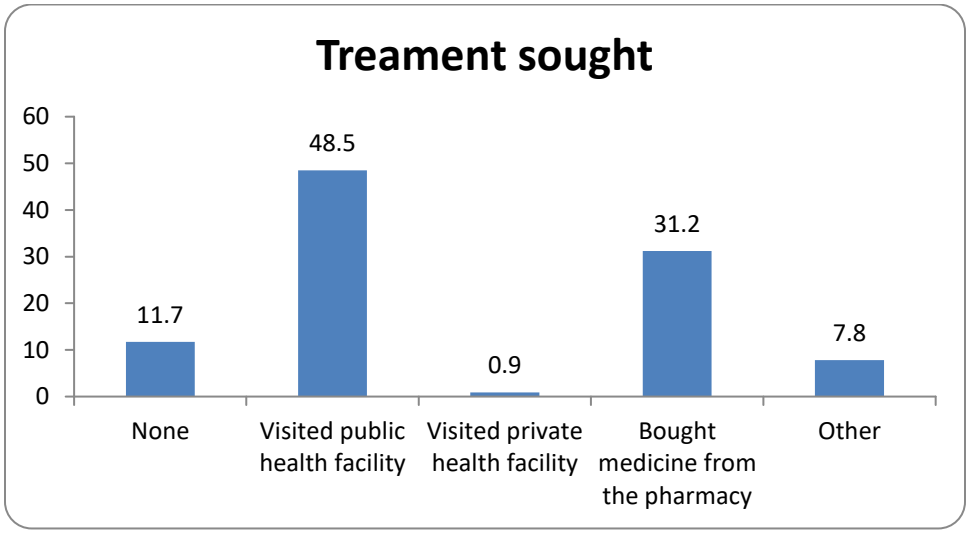

Figure 5: Health seeking practices among mothers in Tadamon

4.3 Infant and young child feeding practices

In this survey, mothers or caregivers with children less than two years were asked about their children's feeding practices over the previous 24 hours. The survey included a total of 243 children for the IYCF assessment in Tadamon locality. The overall sample size and sample sizes calculated for each IYCF indicator are not sufficient to achieve the desired level of precision, thus IYCF results should be interpreted with caution.

About 90.1 percent of all infants and children assessed had ever been breastfed. The proportion of infants initiated to breastfeeding within the first hour of birth was 72.0%, whereas 60.9% of children aged 0-5 months were exclusively breastfed. Timely introduction of complementary feeding in children aged 6-8 months was 57.9%. The percentage of children who fulfilled the minimum dietary diversity stood at 25.4%, while breastfed and non-breastfed children who met the minimum meal frequency was 17.3%. Only a very small percentage of children (2.0%) consumed the minimum acceptable diet.

Table 21: Summary of key IYCF indicators

Indicator	N	n	Proportion (95% C.I)
Children ever breastfed (0-23.9 months)	243	219	90.1 (86.0-93.8)
Early initiation of breastfeeding (0-23.9 months)	243	175	72.0 (66.7-77.4)
Exclusive breastfeeding (0-5.9 months)	46	28	60.9 (45.7-73.9)
Introduction of solid, semi-solid or soft foods (6-8.9 months)	19	11	57.9 (36.8-78.9)

Minimum dietary diversity (6-23.9 months)	197	50	25.4 (19.8-32.0)
Minimum meal frequency for both breastfed and non-breastfed (6-23.9 months)	197	34	17.3 (12.2-22.8)
Minimum acceptable diet (6-23.9)	197	4	2.0 (0.5-4.1)

4.4 Maternal nutrition

The nutritional status of women of reproductive age was determined using the mid-upper arm circumference. According to the survey findings, a greater majority (84.7%) of the women had a normal nutrition status (MUAC≥23). Only 13.4 percent were found to be at risk of malnutrition (MUAC>21-<23), while the remaining 1.9% were found to be malnourished (MUAC<21).

Table 22: Maternal nutrition among women of reproductive age

Indicator	Frequency	Proportion (95% C.I)
MUAC <21cm	6	1.9 (0.6-3.5)
MUAC >21 - <23cm	42	13.4 (9.9-16.9)
MUAC ≥23cm	265	84.7 (80.8-88.2)
Total	313	

5 Discussion

5.1 Nutrition status

5.1.1 Acute malnutrition

The results show the level of GAM in Tadamon was 17.2**%** (13.8-21.3 95% C.I.) which exceeds the WHO emergency threshold of ≥15%. Additionally, the SAM prevalence of 3.4% (2.3-5.2 95% C.I.) is considered high when it's beyond 2% based on observations by agencies that implement routine acute malnutrition screening at the community level.

To interpret this result, several factors need to be considered. First, the survey observed a high morbidity rate of 37.2% which is a risk factor for malnutrition. Existing research points to a strong linkage between morbidity and malnutrition. Secondly, the feeding practices of children in the assessed communities were poor, with nearly all the IYCF indicators falling below the WHO acceptable standard of ≥80%. Poor feeding practices predispose children to both acute and chronic malnutrition. Lastly, access to health and nutrition services was limited, and this makes it difficult to treat and prevent malnutrition.

5.1.2 Underweight

The prevalence of underweight among the children in Tadamon was 27.1% (22.9-31.7 95% C.I.), with 5.9% (3.5-7.2 95% C.I.) being severely underweight. The underweight rate is classified as high per the WHO classification. This level of underweight poses a greater risk of malnutrition in children under five, especially in a fragile context such as Tadamon, and justifies the need to initiate interventions targeting underweight children.

5.1.3 Chronic malnutrition

The results show that the total stunting was high at 25.7% (22.0-29.7 95% C.I.) based on WHO cut-offs. This stunting rate is of great concern considering that the surveyed children also had high levels of wasting and were underweight. This high level of stunting must be tackled through interventions that improve the overall health and nutrition of children in Tadamon.

5.2 Mortality

The crude death rate and the under-five death rate were 0.37 (0.17 - 0.82 95% C.I.) and 0.32 (0.08-1.32) respectively, both of which were below the WHO emergency levels. Despite the high rates of malnutrition and morbidity, low mortality rates were observed. This could be due to two main reasons. One possibility is that recall bias may have led to underreporting of deaths among children under five. Another common error that may have occurred is the omission of deaths due to cultural barriers in which the death of a child may be considered taboo and difficult to discuss. Two, despite the high prevalence of illness, findings revealed that a greater majority of the mothers or caregivers (80.6%) sought medical treatment for their sick children, with 48.5% visiting public health facilities, 0.9% going to private health facilities, and the remaining 31.2% purchasing medicine from pharmacies. These measures could have played a role in preventing child deaths.

5.3 Morbidity

The prevalence of illness among children below the age of five in Tadamon was a concern. More than one-third (37.2%) of children included in the survey had been sick in the 2 weeks before the survey. This shows that Tadamon locality faces a high morbidity burden that needs to be addressed urgently. Given the association between illness and malnutrition, interventions to address childhood morbidity should be prioritized.

5.4 Infant and young child feeding practices

Infant and young child feeding practices were assessed in this survey. An estimated 90.1% of children under the age of 2 years in Tadamon had ever breastfed, indicating that breastfeeding is well regarded and practiced by most mothers or caregivers. However, other core IYCF indicators including initiation to breastfeeding within the first hour of birth (72.0%), exclusive breastfeeding up to 6 months (60.9%), introduction of solid, semi-solid, or soft foods at the age of six months (57.9%), minimum dietary diversity (25.4%.), minimum meal frequency of the breastfed and non-breastfed children (17.3%), and minimum acceptable diet (2.0%) recorded lower rates than the WHO recommendation of ≥80%. Based on these findings, strategies to improve and strengthen IYCF should be implemented.

5.5 Maternal nutrition

According to the survey results, the vast majority of women of reproductive age (15-49 years) had a normal nutrition status (MUAC≥23), 13.8% were at risk of malnutrition (MUAC>21-<23), and the remaining 1.9% were malnourished (MUAC<21). Although the nutritional status of women of childbearing age is not a major concern in this community, steps must be taken to protect the nutritional status of these women because this is one way of ensuring the nutritional status of children born to these mothers is also protected.

6 Conclusion

The prevalence of wasting in Tadamon was above the WHO emergency threshold and requires the continuation and scaling up of current interventions to treat and prevent the high rate of acute malnutrition in this area.

The overall underweight and stunting rates were classified as high based on WHO thresholds. Chronic malnutrition is a burden for the communities living in Tadamon, and it is critical to consider the evidence generated by this survey when planning interventions and programs. To address the problem of chronic malnutrition, additional resources and coordinated efforts by all stakeholders are required.

A significant number of children in Tadamon experienced illness two weeks before the survey. This finding suggests that morbidity is a major health burden for the children in the survey area. Childhood illnesses are a significant contributing factor to both acute and chronic malnutrition, which requires the strengthening and expansion of the current health program to improve access to health services.

The survey revealed sub-optimal infant and young child feeding practices in Tadamon. Poor feeding practices increase the risk of morbidity and malnutrition among children under five. It is critical to continue promoting appropriate IYCF practices through ongoing nutrition education activities, and implement behavior change communication strategies targeting the entire community.

The nutritional status among women of reproductive age in Tadamon was to a large extent, normal. However, given the strong association between maternal nutrition and children's nutritional status, simple and cost-effective interventions to protect the nutritional status of these women should be considered. Such interventions include the provision of nutritional support for women at risk of malnutrition, ongoing health and nutrition education on the value of seeking health services when pregnant or lactating, as well as ways of diversifying household diets.

7 Recommendations

1. Survey findings show that the prevalence of GAM is well above the WHO emergency threshold. Tadamon is underserved by NGOs, and health and nutrition services in local health facilities are inadequate. Interviews with health officials from the State Ministry of Health based in Tadamon indicated that WFP and UNICEF regularly distribute RUSF and RUTF, but supplies are not adequate. The current nutrition interventions should be continued and scaled up to increase coverage. Both the outpatient therapeutic feeding program (OTP) and the targeted supplementary feeding program (TSFP) should be expanded to address the high caseload of GAM and SAM cases identified by the survey. Additionally, active case finding and referral of malnourished children to the nearest health facilities should be intensified.

2. To implement the recommendation to expand the nutrition program coverage in Tadamon, essential nutrition commodities need to be procured and distributed in a timely manner. Health officials in Tadamon as well as the respondents reported that therapeutic and supplementary foods and drugs are in short supply, and frequently beneficiaries go back home without supplies.

3. Total underweight and stunting prevalence were 27.1% and 25.7% respectively, and are considered to be of high public health significance. Given the irreversible negative impact of stunting on the growth and development of children, it is important to focus activities on children under the age of 2. In particular, more resources and efforts for stunting prevention should be availed. This requires the implementation of various multi-sectoral interventions that include but are not limited to the promotion of appropriate infant and young child feeding practices, providing micronutrient supplementation and deworming, and targeting mothers or caregivers with health messages on ways to diversify the household diet, the importance of seeking health services, and observing proper sanitation and hygiene practices.

4. According to survey results, more than one-third (37.2%) of children in Tadamon had suffered from a variety of illnesses. Treatment and prevention of childhood illnesses is urgently needed, but the primary health care centres in this area face challenges such as inadequate and inconsistent supplies, high disease caseloads, and staff shortages. This calls for additional resources to improve access and delivery of health services. For a start, partners can implement regular mobile health clinics and medical outreaches, and support local health facilities with essential medical supplies and recruitment of health workers.

5. Although most mothers and caregivers sought assistance when their children became ill, approximately one-third (31.2%) bought medicine from pharmacies, while 7.8% used alternative treatment options, which are practices that should be discouraged. Intensify community health education to sensitize community members to seek services from health facilities rather than self-medicate or rely on non-medical treatments.

6. Infant and young child feeding programs assessed in this survey were generally poor and fell below accepted standards. This necessitates continuous promotion of appropriate IYCF

practices through intensified health campaigns, regular nutrition education sessions targeting all family members, regular IYCF training for community health and nutrition volunteers, and using mother support groups to promote recommended IYCF practices, among other strategies.

7. While the survey found that most women of reproductive age had a normal nutritional status, several of the women were at risk of malnutrition or were already malnourished. This highlights the need to target these women with interventions, particularly during pregnancy and the lactation period to guarantee the best possible start for their children. Various approaches should be considered such as regular screening for malnutrition, enrolling and treating malnourished pregnant and lactating women, providing continuous health education on health-seeking during pregnancy, optimal child care and feeding practices, diet diversification, proper sanitation, and hygiene practices.
8. Conduct biannual pre-harvest and post-harvest SMART surveys to monitor the nutrition situation throughout the year. The current survey is the first successful nutrition assessment that was conducted in Tadamon, and the results will serve as a baseline for future reference

8 Appendices

Appendix 1: Plausibility report

Overall data quality

Criteria	Flags*	Unit	Excel.	Good	Accept	Problematic	**Score**
Flagged data	Incl	%	0-2.5	>2.5-5.0	>5.0-7.5	>7.5	
(% of out of range subjects)			0	5	10	20	**0** (1.9 %)
Overall Sex ratio	Incl	p	>0.1	>0.05	>0.001	<=0.001	
(Significant chi square)			0	2	4	10	**0** (p=0.841)
Age ratio(6-29 vs 30-59)	Incl	p	>0.1	>0.05	>0.001	<=0.001	
(Significant chi square)			0	2	4	10	**4** (p=0.026)
Dig pref score - weight	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	**0** (5)
Dig pref score - height	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	**2** (10)
Dig pref score - MUAC	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	**0** (7)
Standard Dev WHZ	Excl	SD	<1.1	<1.15	<1.20	>=1.20	
.			and	and	and	or	
.	Excl	SD	>0.9	>0.85	>0.80	<=0.80	
			0	5	10	20	**0** (0.96)
Skewness WHZ	Excl	#	<±0.2	<±0.4	<±0.6	>=±0.6	
			0	1	3	5	**0** (-0.11)
Kurtosis WHZ	Excl	#	<±0.2	<±0.4	<±0.6	>=±0.6	
			0	1	3	5	**0** (-0.13)
Poisson dist WHZ-2	Excl	p	>0.05	>0.01	>0.001	<=0.001	
			0	1	3	5	**1** (p=0.048)
OVERALL SCORE WHZ =			0-9	10-14	15-24	>25	**7** %

The overall score of this survey is 7 %, this is excellent.

Appendix 2: List of selected clusters

Geographical unit	Population size	Cluster
Tartar gablab	3900	1
Tartar Abu shidara	1920	2
Tartar Souq district	2700	3
Tartar hilat Sholok	900	4
Tartaar Aiash	2700	5
Tartar dibaba	1620	6
Tartar Mekhneig	2700	7,8
Tartar Siragia	3600	9
Kailan	840	10
Adaba Al tartar	1440	11
Habila	480	RC
Abu riglin Sharg	720	12
Alazrag	390	13
Alramal	150	14
Algadol	720	15
Um bayod	1500	16
Alhamira	792	17
Gadom Algabal	894	RC
Raiba	2826	18
Um Doka	300	19
Alardaiba	2400	20,RC
Saror	2580	21
Umgidad	1920	22
Mohamed Nour	510	23
Gardod abdelsalam	1980	24
Hilat Gawama	1398	25
Hilat Falata	1680	26
Wakara city Sabrain	2100	27
Almagar	858	28
Sifaifir	960	29
Balola Madina	870	30
Algidehat	720	31
Al Helila	270	32
Dar maili	270	33
Kohly West	372	34

Totah	1074	35
Um elkhairat	2280	36
Hai Elsouq	1590	37
Alhafira	2520	38
Alqtar	390	RC
Alezeirg	960	39

Appendix 3: Standardization test results

Standardisation test results					Precision				Accuracy		OUTCOME			
Weight		subjects	mean	SD	max	Technical error	TEM/ mean	Coef of reliability	Bias from superv	Bias from median			From	From
		#	kg	kg	kg	TEM (kg)	TEM (%)	R (%)	Bias (kg)	Bias (kg)			Supervisor	Median
	Supervisor	10	9.8	2.7	0.2	0.07	0.7	99.9	0	0.06	TEM acceptable	R value good	Bias good	Bias acceptable
	Enumerator 1	10	9.8	2.7	0	0	0	100	0.11	0.06	TEM good	R value good	Bias poor	Bias acceptable
	Enumerator 2	10	9.7	2.7	0.6	0.15	1.5	99.7	0.11	0.08	TEM poor	R value good	Bias poor	Bias acceptable
	Enumerator 3	10	9.8	2.7	0.2	0.06	0.6	100	0.08	0.02	TEM acceptable	R value good	Bias acceptable	Bias good
	Enumerator 4	10	9.8	2.7	0.2	0.07	0.7	99.9	0.08	0.03	TEM acceptable	R value good	Bias acceptable	Bias good
	Enumerator 5	10	9.8	2.7	0.3	0.1	1	99.9	0.11	0.06	TEM poor	R value good	Bias poor	Bias acceptable
	Enumerator 6	10	9.8	2.7	0.2	0.1	1	99.9	0.1	0.04	TEM acceptable	R value good	Bias acceptable	Bias acceptable
	Enumerator 7	10	9.8	2.7	0.2	0.1	1	99.9	0.09	0.04	TEM acceptable	R value good	Bias acceptable	Bias good
	Enumerator 8	10	9.8	2.7	0.2	0.08	0.8	99.9	0.08	0.02	TEM acceptable	R value good	Bias acceptable	Bias good
	Enumerator 9	10	9.8	2.7	0.2	0.06	0.6	100	0.06	0.03	TEM acceptable	R value good	Bias acceptable	Bias good
	enum inter 1st	9x10	9.8	2.6	-	0.07	0.7	99.9	-	-	TEM good	R value good		
	enum inter 2nd	9x10	9.8	2.6	-	0.11	1.1	99.8	-	-	TEM acceptable	R value good		
	inter enum + sup	10x10	9.8	2.6	-	0.09	0.9	99.9	-	-	TEM good	R value good		
	TOTAL intra+inter	9x10	-	-	-	0.13	1.3	99.8	-	-	TEM acceptable	R value good		

	TOTAL+ sup	10x10	-	-	-	0.13	1.3	99.8	-	-	TEM acceptable	R value good		
Height		subjects	mean	SD	max	Technical error	TEM/ mean	Coef of reliability	Bias from superv	Bias from median			From	From
		#	cm	cm	cm	TEM (cm)	TEM (%)	R (%)	Bias (cm)	Bias (cm)			Supervisor	Median
	Supervisor	10	81.3	11.6	1.3	0.4	0.5	99.9	0	0.43	TEM acceptable	R value good	Bias good	Bias acceptable
	Enumerator 1	10	82.2	10.9	1.1	0.39	0.5	99.9	1.33	1.06	TEM good	R value good	Bias poor	Bias poor
	Enumerator 2	10	81.7	11.2	5.3	1.7	2.1	97.7	1.26	0.91	TEM reject	R value acceptable	Bias poor	Bias poor
	Enumerator 3	10	81.4	11.5	1	0.28	0.3	99.9	0.45	0.35	TEM good	R value good	Bias acceptable	Bias good
	Enumerator 4	10	81.3	11.4	1.7	0.58	0.7	99.7	0.52	0.32	TEM acceptable	R value good	Bias acceptable	Bias good
	Enumerator 5	10	81.6	11.3	1.4	0.37	0.5	99.9	0.66	0.36	TEM good	R value good	Bias acceptable	Bias good
	Enumerator 6	10	83.6	9.6	5	1.28	1.5	98.2	3.06	2.73	TEM reject	R value acceptable	Bias reject	Bias reject
	Enumerator 7	10	81.1	11.2	1.6	0.59	0.7	99.7	0.96	0.59	TEM acceptable	R value good	Bias poor	Bias acceptable
	Enumerator 8	10	81.3	11.4	1.3	0.44	0.5	99.8	0.54	0.22	TEM acceptable	R value good	Bias acceptable	Bias good
	Enumerator 9	10	81.4	11.4	1.1	0.42	0.5	99.9	0.52	0.22	TEM acceptable	R value good	Bias acceptable	Bias good

	enum inter 1st	9x10	81.7	10.9	-	2.04	2.5	96.5	-	-	TEM reject	R value acceptable		
	enum inter 2nd	9x10	81.8	10.9	-	2.33	2.9	95.4	-	-	TEM reject	R value acceptable		
	inter enum + sup	10x10	81.7	10.9	-	2.11	2.6	96.3	-	-	TEM reject	R value acceptable		
	TOTAL intra+inter	9x10	-	-	-	2.34	2.9	95.4	-	-	TEM reject	R value acceptable		
	TOTAL+ sup	10x10	-	-	-	2.25	2.8	95.8	-	-	TEM reject	R value acceptable		
MUAC		subjects	mean	SD	max	Technical error	TEM/ mean	Coef of reliability	Bias from superv	Bias from median			From	From
		#	mm	mm	mm	TEM (mm)	TEM (%)	R (%)	Bias (mm)	Bias (mm)			Supervisor	Median
	Supervisor	10	13.7	1	0.4	0.12	0.9	98.5	0	0.25	TEM good	R value acceptable	Bias good	Bias good
	Enumerator 1	10	13.5	1.1	1	0.26	1.9	94.4	0.37	0.19	TEM good	R value poor	Bias good	Bias good
	Enumerator 2	10	13.5	1.1	0.6	0.21	1.6	96	0.36	0.2	TEM good	R value acceptable	Bias good	Bias good

	Enumerator 3	10	13.6	1.1	0.5	0.17	1.3	97.7	0.28	0.19	TEM good	R value acceptable	Bias good	Bias good
	Enumerator 4	10	13.5	1.1	0.3	0.12	0.9	98.9	0.31	0.15	TEM good	R value acceptable	Bias good	Bias good
	Enumerator 5	10	13.8	1.2	1.3	0.32	2.3	93.4	0.27	0.27	TEM good	R value poor	Bias good	Bias good
	Enumerator 6	10	13.3	1.1	0.7	0.21	1.6	96.6	0.53	0.32	TEM good	R value acceptable	Bias good	Bias good
	Enumerator 7	10	13.3	1.2	0.8	0.29	2.2	94	0.61	0.34	TEM good	R value poor	Bias good	Bias good
	Enumerator 8	10	13.8	1	1	0.38	2.7	86.6	0.32	0.37	TEM good	R value reject	Bias good	Bias good
	Enumerator 9	10	13.6	1.1	0.6	0.27	2	93.9	0.31	0.21	TEM good	R value poor	Bias good	Bias good
	enum inter 1st	9x10	13.5	1.1	-	0.31	2.3	92.1	-	-	TEM good	R value poor		
	enum inter 2nd	9x10	13.5	1.1	-	0.39	2.9	88.2	-	-	TEM good	R value reject		
	inter enum + sup	10x10	13.6	1.1	-	0.34	2.5	90.5	-	-	TEM good	R value poor		
	TOTAL intra+inter	9x10	-	-	-	0.43	3.2	84.7	-	-	TEM good	R value reject		
	TOTAL+ sup	10x10	-	-	-	0.42	3.1	85.1	-	-	TEM good	R value reject		
Suggested cut-off points for acceptability of measurements														

Parameter		MUAC mm	Weight Kg	Height cm										
individual	good	<2.0	<0.04	<0.4										
TEM	acceptable	<2.7	<0.10	<0.6										
(intra)	poor	<3.3	<0.21	<1.0										
	reject	>3.3	>0.21	>1.0										
Team TEM	good	<2.0	<0.10	<0.5										
(intra+inter)	acceptable	<2.7	<0.21	<1.0										
and Total	poor	<3.3	<0.24	<1.5										
	reject	>3.3	>0.24	>1.5										
R value	good	>99	>99	>99										
	acceptable	>95	>95	>95										
	poor	>90	>90	>90										
	reject	<90	<90	<90										
Bias	good	<1	<0.04	<0.4										
	acceptable	<2	<0.10	<0.8										
	poor	<3	<0.21	<1.4										
	reject	>3	>0.21	>1.4										

Appendix 4: Data collection tools

DEMOGRAPHY & MORTALITY QUESTIONNAIRE

DATE OF INTERVIEW: [D][D]/[M][M]/ [Y][Y]

01	02	03	04	05	06	07	08	09	10
No.	Name	Sex (M/F)	Age (years)	Joined on or after: [ ][ ] (Start date of the recall period - ex. Jan. 1, 1900) WRITE 'Y' for YES. Leave BLANK if NO.	Left on or after:	Born on or after: HOUSEHOLD[9] NO.	Died on or after:	Cause of death 1= illness 2=injury 66=unknown	Location of death 1=current location 2=during migration 3=in place of last residence 4=other
a) List all the people that slept in this household last night.									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
b) List all the people that slept in this household on the **first night of the recall period (FILL IN DATE/EVENT)** but did **NOT sleep** in the **household last night**.									
1					Y				
2					Y				
3					Y				
4					Y				
5					Y				
6					Y				
7					Y				
c) List all the people that slept in this household on the **first night of the recall period but have since died**									
1							Y		
2							Y		
3							Y		
4							Y		
5							Y		
Was anyone in the household pregnant at the start of the recall period? No [ ] Yes [ ] If yes, how many? _____									

[9] HH definition: Group of people living under same roof & sharing food from the same pot for a period of at least 6 months. In home with multiple wives, those living and eating in different houses are considered as separate HHs. Wives living in different houses and eating from same pot are considered as one HH.

ANTHROPOMETRIC & HEALTH QUESTIONNAIRE

استمارة القياسات الجسمانية و الصحة

(To be conducted in EVERY SELECTED HH with children 6-59 months and PLWs)

علي ان يتم ملأها في كل منزل تم اختياره مع الأطفال من عمر 6 الي 59 شهر و الحوامل و المرضعات

Date (DD/MM/YY): …./……/…..... Cluster No:…… Team No…..… State:…….. District……..…….. Division:……
Location……..…….. Village:……...……

1	2	3	4	5	6	7	8	9	10	12	13	14	15	17
Child No.	HH NO	Child Name	Sex **m** = Male **f** = Female	Date of Birth (DD/MMYY)	Age in months	Weght in Kg (eg 12.4)	Height in cm (eg 78.1)	Oedema No =0 **1** =Yes	MUAC in cm (eg 11.3)	Measles Vaccineat 9 month **0** = No **1** =Yes with EPI card **2** =Yes mother recall **3** = Child <9m	Illness in past 14 days? **0** = No **1** =Yes If no, go to 16	Type of Illness **1** = Fever **2** = Cough **3** = Diarrhoea 99 = Other (specify)	Treatment Sought: **0** = None **1** =Hospital **2** =PHCC/U **3** = Mobile /outreach clinic 4=Private clinic 5=Traditional practitioner 6= Pharmacy/chemist **99**=Other (Specify)	Pregnant and Lactating Women (PLW) MUAC _____cm
رقم الطفل	رقم المنزل	اسم الطفل	النوع/الجنس	تاريخ الميلاد (يوم يوم/شهر شهر/سنة)	العمر بالشهور	الوزن بالكيلو جرام(مثلا 12.4 كجم)	الطول/الارتفاع بالسنتمتر (مثلا cm78.1)	ورم لا=0 نعم= 1	مقياس محيط منتصف العضد بالسنمتر (مثلا c11.3 m)	التطعيم ضد الحصبة في الشهر التاسع لا= 0 نعم مع وجود كرت تطعيم=1 نعم الام تذكرت =2 الطفل اصغر من 9 شهور=3	الامراض خلال 14 يوم لا=0 نعم=1 اذا كانت الإجابة لا تخطي الي 16	نوع المرض 1 = حمي 2 = كحة 3 = اسهال 99 = اخري (حدد)	طلب العلاج: لم يتم = 0 مستشفي = 1 وحدة/مركز صحي = 2 عيادة جوالة= 3 عيادة خاصة = 4 معالج تقليدي = 5 صيدلي = 6 اخري = 99 (حدد)	ققياس منتصف محيط العضد للحوامل و المرضعات : قراءة المواك (بالسنمتر)
1														
2														
3														
4														

5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														

INFANT AND YOUNG CHILD FEEDING CHILD FEEDING QUESTIONNAIRE

Date (D/M/Y): ……/……/….. Cluster No:…… Team No…..… State:…….. locality…….…….. Village:……...														Date (D/M/Y): ……/……/…..... Cluster No:…… Team No…..… State:…….. locality…….…….. Village:……...……												
Identification					**INFANT AND YOUNG CHILD FEEDING (0 TO 23 MONTHS) PART A**									**INFANT AND YOUNG CHILD FEEDING (0 TO 23 MONTHS) PART B**											
11	11.1	11.2	11.3	11.4	11.5	11.6	11.7	**11.8 Yesterday, during the day or at night, did [NAME] receive any of the following liquids?**						**11.8….Yesterday, during the day or at night, did [NAME] receive any of the following liquids?**			**11.9 Describe what did (NAME) eat yesterday during the day or night, whether at home or outside the home since (NAME) woke up yesterday until NAME went to sleep?**							11.10 How many times did [child's name] eat solid or semi-solid food other than liquids yesterday during the day or at night? (number of times)	11.11 Yesterday during the day/night, did [child's name] consume any food given by a health centre for the treatment of malnutrition (Plumpy'Nut, Plumpy'sup, Plumpy'Nut dose, sprinkles/sachet etc) OR fortified food (porridge consisting of several	11.12
HH No.	Child No.	Child Name	Sex M=Male F=Female	Age in months (0-23 months)	Has [NAME] ever been breastfed? (EverBF) 1= Yes 0 = No 8 = Don't know	How long after birth did you first put [NAME] to the breast? 1 = Less than one hour 2 = Between 1 and 23 hours 3 =More than 24 hours 8 =	Is (Name) still breastfeeding now? 1= Yes 0 = No 8 = Don't know	Plain water **1= Yes 0 = No 8 = Don't know**	Infant formula ____ times	Milk such as tinned, powdered, or fresh animal milk ____ times	Sour milk or Yoghurt ____ times	Juice or juice drinks 1= Yes 0 = No 8 = Don't know	HH No.	clear Broth 1= Yes 0 = No 8 = Don't know	Thin Porridge 1= Yes 0 = No 8 = Don't know	Other water base liquids 1= Yes 0 = No 8 = Don't know	Cereals, flours, grains, roots and tubers (Maize, Sorghum, potatoes, cassava) 1= Yes 0 = No 8 = Don't know	legumes and nuts (Beans, Peas, Lentils, Nuts and Seeds) 1= Yes 0 = No 8 = Don't know	dairy products (milk, yogurt, cheese) 1= Yes 0 = No 8 = Don't know	flesh foods (meat, fish, poultry and liver/organ meats) 1= Yes 0 = No 8 = Don't know	eggs 1= Yes 0 = No 8 = Don't know	vitamin-A rich fruits and vegetables (carrot, red pepper, pumpkin, Ripe Mangoes, papaya) 1= Yes 0 = No 8 = Don't know	other fruits and vegetables (Avocado, Banana, Apple, Grapes, Guava, Lemon, Pinapeale, Cabbage, onions, tomatoes, etc 1= Yes 0 =			Pregnant and Lactating Women (PLW) MUAC ____cm

						Don’t know																	No 8 = Don’t know		meal mixed, CSB) OR any food with added a micronutrient powder (MNP)? 1= Yes 0 = No 8 = Don’t know	

Appendix 5: Local calendar of events

SMART

Tadamon Event Calendar

Months	Seasons	2017		2018		2019		2020		2021		2022	
Jan	cold season	New Year's Day/Independence Day		New Year's Day/Independence Day	51	New Year's Day/Independence Day	39	New Year's Day/Independence Day	27	New Year's Day/Independence Day	15	New Year's Day/Independence Day	3
Feb	End of the cold season				50		38		26		14		2
Mar	Dry season				49		37		25		13	Governor's visit to Tadamun	1
April	Dry season				48	Bashir overthrown	36		24		12		0
May	Dry season	Eid al-Fitr Arrival of nomads	59	Eid al-Fitr Arrival of nomads	47	Eid al-Fitr Arrival of nomads	35	Eid al-Fitr Arrival of nomads	23	Eid al-Fitr Arrival of nomads	11		
June	Dry season		58		46		34		22		10		
July	Beginning of the rainy season	Eid al-Adha	57	Eid al-Adha	45	Eid al-Adha	33	Eid al-Adha	21	Eid al-Adha	9		
Aug	Rainy season		56		44		32	Serror's floods	20		8		
Sept	Rainy season		55		43		31		19		7		
Oct	Rainy season	Leaving of nomads from Tadamun/ Harvesting of sesame crop (Jingo season)/ Main harvest	54	Leaving of nomads from Tadamun/ Harvesting of sesame crop (Jingo season)/ Main harvest	42	Leaving of nomads from Tadamun/ Harvesting of sesame crop (Jingo Season)/ Main harvest	30	Hawazma & Awlad Hameed's conflict/ Leaving of nomads from Tadamun/ Main harvest	18	Leaving of nomads from Tadamun/ Harvesting of sesame crop (Jingo season)/ Main harvest	6		
Nov	Harvesting of sesame crop (Jingo season)	Harvesting of sesame crop (Jingo season)	53	Harvesting of sesame crop (Jingo season)	41	Harvesting of sesame crop (Jingo season)	29	Harvesting of sesame crop (Jingo season)	17	Harvesting of sesame crop (Jingo season)	5		
Dec	Beginning of the cold season	Christmas	52	Start of Protests/fire at the locality's centre	40	Christmas	28	Christmas	16	Christmas/ Megenis conflict	4		